

BACK SCATTER

Illuminating atmospheric aerosols

This green laser light was shined into the skies over Leipzig, Germany, as part of an effort to build a profile of atmospheric particulates. The MARTHA (Multiwavelength Atmospheric Raman Lidar for Temperature, Humidity, and Aerosol Profiling) instrument at Leipzig's Leibniz Institute for Tropospheric Research collects returning radiation that has bounced off aerosol particles and measures the polarization and scattering properties. Lidar data is used, along with physical particulate counts, in weather, climate, and environmental modeling. But the method has limitations: In high atmospheric layers, it confounds volcanic sulphates with smoke, and in low layers, it confounds smoke with urban pollution. To address the classification difficulties, MARTHA was updated in 2022 to also collect fluorescence backscatter, radiation emitted by particles that absorb the laser light.

Benedikt Gast and his team put the upgraded MARTHA to the test in the spring and summer of 2023, when plumes of sooty aerosols from Canadian forest fires were moving through Europe. The researchers found that by analyzing the fluorescence data, they were able to identify various types of smoke. The observations revealed thin layers of wildfire smoke at high altitudes. The layers, otherwise undetectable by conventional lidar, suggest that the upper atmosphere over Europe is more polluted than previously thought, particularly during the summer wildfire season.

Because pure water does not fluoresce, MARTHA can distinguish between dry aerosols and small water particles in clouds. That capability may enable future studies of cloud formation. (B. Gast et al., *Atmos. Chem. Phys.* **25**, 3995, 2025; photo courtesy of Tilo Arnhold, TROPOS.) —MC

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